

# THE MODEL ENGINEER

Vol. 86 No. 2140

Percival Marshall & Co., Limited  
Cordwallis Works, Maidenhead

May 14th, 1942

## Smoke Rings

### A Bulawayo Gold Mine

**H**OW a reader discovered unexpected gold in a shop in Bulawayo, in Southern Rhodesia, is related by Corporal Reeves of the R.A.F. It appears that, though a keen model engineer when in the home country, he had been separated from his workshop and his "M.E." for quite a period while on active service. In a shop in Bulawayo he discovered by chance a copy of the "M.E." and on enquiry found that a further 17 copies had accumulated in stock to the order of a customer who had failed to collect them. Corporal Reeves purchased the lot, a "lucky strike" of gold to an enthusiastic model engineer. He writes that he anticipates many hours of pleasure in reading them. Before going abroad he had been busy building a model of a Fowler steam ploughing engine, and he hopes to take this up again when the war is over. He says that the Rhodesians are most hospitable to their Service visitors, but so far he has not discovered any local model engineers. Materials for engineering models are difficult to obtain, and such model making as is done is restricted to wooden models of aircraft.

### Malaya Memories

**M**R. J. T. FOXON, who contributed a beautifully-made table engine to our 1938 exhibition, has been good enough to send me some old snapshots of a model steam boat made many years ago in Malaya. Too busy at the time to do any model making himself, he gave a few sketches of a simple model steamer to one of his Malay apprentices, with the result that a very creditable working model was produced. One of the snaps shows a crowd of native boys collected round the boat as it was being launched in the water. The look of interest on their faces shows how universal is the human appeal of a working model. Mr. Foxon, whose friendship with the "M.E." dates from No. 1, returned to this country some ten years ago, and has resumed his active model making work. In addition to his table engine, this includes two grandfather electric clocks, a half-inch scale

working model of a G.W.R. broad gauge engine, and some progress on a glass case model, to a scale of 1 inch, of a Dundee and Newtyle locomotive, which is promised for our next exhibition. Not a bad record this!

### Spare-time Munitions Work

**F**OLLOWING the appeal made in our issue of April 23rd for voluntary workers for a night-shift in a North London factory, I am asked by the sponsors of the scheme to thank the many readers who have been good enough to offer their services. The appeal was made directly to those resident in the North London area, but a number of replies have also been received from more remote parts of the country, and it is regretted that it will not be possible to fit distant workers into the present scheme. For the information of North London readers who have not yet replied, I may repeat that the address of the organisers is Messrs Howard Tenens Ltd., Bevis House, Bevis Marks, London, E.C.3.

### High-speed Steel Scrap

**T**HE Ministry of Supply calls attention to the urgent need for economy in the using of small tools of high-speed steel such as drills, reamers, milling cutters, and taps, and for the saving of all pieces of such steel which might otherwise be regarded as scrap. Scrap pieces of high-speed steel can be used for tipping tools made of carbon steel, and in other ways made to render continued workshop service. The Ministry says that there is probably enough high-speed steel in the hands of users in this country to last until the end of the war if it were all either turned in as scrap, or recovered and used as other tools. Until recently many high-speed steel tools were made throughout of high-speed steel. The modern method is to produce tools of which the cutting part only is made of high-speed steel. For this reason broken parts of solid high-speed steel tools form particularly valuable scrap.

*Percival Marshall*

# "CURLY'S ENGINE"—STEPNEY

By "L.B.S.C."

FOLLOWERS of these notes who are interested in the adventures of young "Curly"—and there are plenty of them!—have given me a gentle reminder that the promised photo. of "Curly's engine" (the "Terrier" *Stepney*) has not yet appeared, and suggest that some details of her might be included, as the younger readers "know not" of those wonderful little machines. Several have also suggested that a few notes on building a small edition of her, as a sort of memento, would also prove acceptable; so, provided our good friend the K.B.P. is agreeable, I will proceed to kill the two birds with one brick. I have to thank my good friend Mr. O. J. Morris for the picture; incidentally, his locomotive photographs are known all over the world, and he is also a well-known writer on locomotive topics in the journals devoted to full-size practice.

The photo. was taken at Brighton in the early years of the present century, some while after the little engine had been transferred from the London area to Brighton sheds, and was working on the Kemp Town and other short branches, besides doing pilot-duty at Brighton Central station. "Curly," by that time, was twice the age at which he first made her acquaintance; and, by aid of the good offices of Driver Jones, had long since been taken into the Locomotive Dept. of his dearly-loved London Brighton and South Coast Railway.

New readers who wondered what the letters at the top of these notes stood for need now wonder no longer! I might add that the knowledge of enginemanship, both oral and practical, given to "Curly the child" by that worthy and kindly man, proved invaluable in after life; he was the identical type of driver whom Michael Reynolds described in his books as the "model locomotive engineer," the meaning of the adjective in this case being just the reverse to what is usually implied, inasmuch as he was something to copy, instead of being a copy of something. He was the only sort of "model" that I ever had any use for!

Incidentally, it is passing strange, to say the least of it, how a small and absolutely insignificant incident may alter completely the whole chain of events in a person's life. Had not that gust of wind scattered the

stationmaster's papers, I should have passed him and the driver without speaking; probably I should never have known the latter, and my life may have taken a different course altogether, as I should never have "served my apprenticeship" in the way described. Probably even these notes would never have been written; but that wouldn't have been much loss, anyway!

## Details of the "Terriers"

Rumour has it that when "old man Billy" came to Brighton from the Highland Railway in 1871, and saw the awful heterogeneous mass of animated scrap-iron that he was expected to turn into good working locomotives, the shock nearly bounced him back to Bonnie Scotland again! I know "in proportion" what he must have felt like, for some of the alleged engines I have rebuilt in past years gave me the same kind of feeling, especially the sort with grass-hopper valve gears and dry-backed boilers made from castings. However, he set to work to bring order out of chaos, and made a very good job of it; meantime, he had to provide new locomotive power for the South and East London lines. The traffic was not paying sufficiently to warrant the relaying of the permanent way with heavy steel rails in place of the existing light iron ones; and what with the road being in poor condition, and the heavy banks, the problem of a suitable engine needed some solving. However, "Billy" solved it, and in no half-hearted way at that; the Stroudley "Terriers" gained world-wide fame. There were fifty of them altogether, and it is safe to assert that no engine of equal weight and dimensions, built either before or since, has ever equalled the performance of these "mighty atoms," let alone beaten it.

Though the last one came out in 1880, there are still a number at work, three being in the Isle of Wight. Many were sold; some came back to their original owners through the grouping and amalgamation, and the Great Western now have two of them, taken over from the Weston and Portishead line, so they will be all right if they need a spare engine for the "Cornish Riviera" any time! Joking apart, however, little *Brighton* herself showed the Frenchmen how to do it, when she worked an express train from Paris to Dieppe in 1878; and in later years, one of their

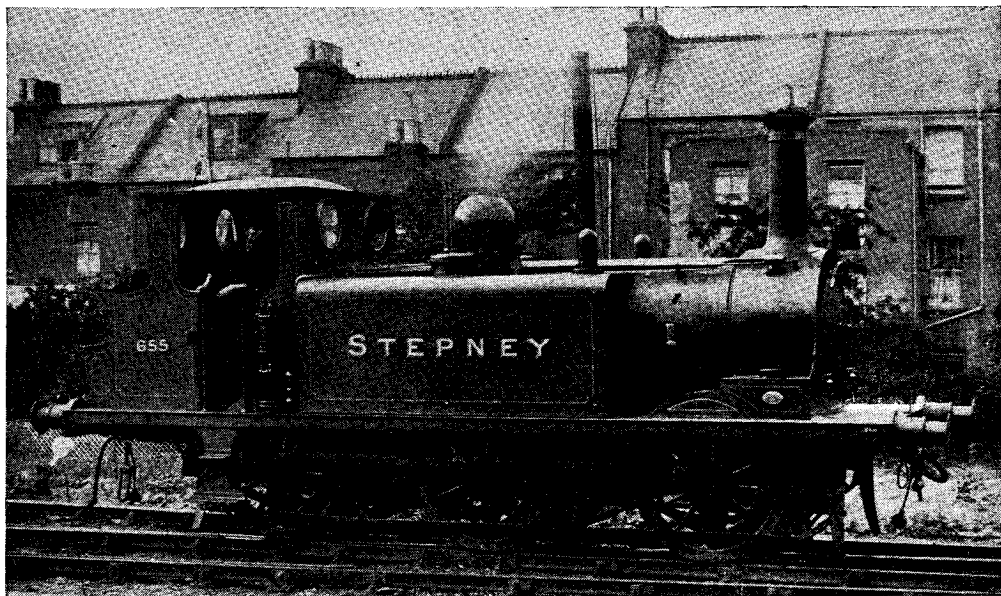


Photo by]

[O. J. Morris

**“Curly’s Engine.” (The engineman shown is *not* Curly.)**

regular duties was to bring up the London Bridge halves of the day mail and boat trains from East Croydon, the tender engine going to Victoria with the other half. These trips were made at express timing, and many a time I have seen them go through New Cross at “over sixty,” the coupling-rods being very nearly invisible in a blur.

The dimensions are as follows: Length over buffer beams, 23 ft. 2½ in. Coupled wheels, 4 ft. diameter at 6 ft. centres. Cylinders, 13 in. by 20 in. (later bored out to 14 in. on some of the engines), set 2 ft. 3 in. apart, and pitched at an angle of 1 in 11. The back covers were in one piece with the cylinders. The valve gear was Stephenson link, reversed by a lever, the valve travel being 3½ in. in full gear. The fact that “Curly” could notch it up with steam on is ample proof of its excellent design and construction, even though “Curly” had abnormal strength for a kid of his age and size.

The boiler had a barrel 7 ft. 10 in. long and 3 ft. 5½ in. diameter, with a firebox wrapper 4 ft. 1 in. long and 3 ft. 6½ in. wide. There were 121 tubes of 1½ in. diameter and 8 ft. 4½ in. long, giving a total heating surface of 518 sq. ft. As the grate area was only 10 sq. ft., the engines could very nearly be kept on the pin, using a teaspoon to fire with. The boiler feed was by two crosshead pumps, the working pressure 140 lb. and the total weight 24 tons 7 cwt. As the boiler centre was only 5 ft. 8½ in. from rail

level, and the top of the chimney 11 ft. 3 in., you can easily see that a driver of “Curly’s” size matched the little engines very well indeed.

When I first made *Stepney’s* acquaintance, she—in common with all the Stroudley tank engines—had two copper pipes leading from the smokebox to the side tanks, for the purpose of taking part of the exhaust steam into the tanks and warming up the feed water. Stroudley’s successor, “Bob” Billinton, had these removed as the engines went in for overhaul; and when *Stepney* went to Brighton about the turn of the century, she lost hers, as the photo. shows, although the “dollies” or exhaust domes were still left on top of the tanks. She was renumbered 655 when the 4-4-0 *Emperor* came out and sneaked her old number—55—in July, 1901. *Emperor*, incidentally, was one of the engines which the “Brighton” bought from Sharp, Stewart’s at what the old Scottish travelling engineer called “tomato price,” viz. 2½d. per lb., which was exactly what it worked out at, as far as I recollect! The abolition of the exhaust pipes was an Irish sort of “improvement,” as the little engines always had a healthy exhaust crack, and when the additional steam was turned up the chimney this was naturally intensified, with a corresponding increase in the coal consumption. Further to “improve” matters, the boiler feed was, of course, stone cold. Some folk have funny ideas about efficiency!

**Hints on a Small Edition**

The size I would recommend for a little "Terrier" would be  $3\frac{1}{2}$ -in. gauge. In this size it would come out about the same dimensions as a normal  $2\frac{1}{2}$ -in. gauge 0-6-0 tender or tank engine; and as  $1/16$  in. equals 1 in. full size, it is easy to get the dimensions. Also, which is important, all the detailed instructions I have given for building the L.M.S. 0-6-0 "Molly" could be utilised for the Brighton engine, merely altering the sizes to suit. Sheet steel of  $3/32$  in. thickness would do nicely for the frames, keeping to the  $3\frac{1}{2}$ -in. outside width. From front of frame to leading axle  $3\frac{1}{2}$  in., leading to driving and driving to trailing centres  $4\frac{1}{2}$  in. each, and from trailing centre to end of frame 5 in. Buffer beams  $\frac{3}{4}$  in. by  $\frac{1}{2}$  in. angle,  $5\frac{1}{2}$  in. long; rail to top of beam  $2\frac{1}{2}$  in. Horns and axleboxes, same as ordinary  $2\frac{1}{2}$ -in. gauge engine; wheels 3-in. diameter. Cylinders  $13/16$  in. by  $1\frac{1}{4}$  in.; and if the centres are spaced the "scale" distance apart, viz,  $1\frac{11}{16}$  in., you have  $\frac{1}{2}$  in. between the bores, which gives ample room to place the slide valves in between, and use a link motion similar to that given for "Molly," but leaving out the rocking levers and connecting the intermediate valve spindles direct to the pair sticking out of the steam chest. The two cylinders could be either separate castings or rectangular blocks of gunmetal or bronze, with a single box-shaped steam chest in between the two, the whole issue being held together by long bolts made from  $\frac{1}{2}$ -in. steel rod nutted at both ends, the nuts being sunk into pin-drilled recesses on the outside of the cylinder blocks. For boiler feeds, a little crosshead pump with  $\frac{1}{2}$ -in. ram could be screwed to the frame at each side, the rams being attached to the slide blocks.

The boiler would be a weeny-weeny affair, but you can take my word for it that it would steam like billyho. The barrel would be  $2\frac{1}{2}$  in. diameter (the "scale" size over lagging) and 6 in. long, the firebox wrapper being  $3\frac{1}{2}$  in. long, and the bottom of the firebox about 3 in. below the centre line of the boiler. The inside firebox should fit the wrapper so as to leave a  $3/16$ -in. water space at sides and back; and by putting the crown sheet only a very little above the centre line, there is plenty of room for seven  $\frac{3}{4}$ -in. by 22 or 24 gauge tubes, and an  $11/16$ -in. or  $\frac{3}{4}$ -in. superheater flue. The crown-sheet should be arched slightly, and stayed by my usual system of girders. The bottom of the firebox would be level, instead of being sloped like "Molly's," and the same kind of grate and ashpan could be used, though the top of the latter would not, of course, need cutting on the slant, but would be the same depth at both front and

back. The boiler fittings as described for "Molly" would do very well; but a cam-operated pin regulator, or one of the disc-in-a-tube pattern, should be used in preference to one in the dome, as the latter is very small. But don't forget the little pair of spring-balance safety valves, or the appearance will be spoiled entirely; if you are doubtful about your ability to make them, there is a simple substitute which only a party with X-ray optics could detect. Sink an ordinary spring safety valve into the top of the dome, and fix up a tiny pair of dummy balance levers and spring cases, connecting the levers to the pin of the actual valve. This will give the desired effect.

The barrel of the chimney should be  $\frac{3}{4}$ -in. diameter, and the top of the copper cap should stand  $2\frac{1}{4}$  in. above the smokebox; the centre line of the boiler should be  $4\frac{5}{16}$  in. from rails. The dome should be  $1\frac{1}{4}$  in. diameter and the same height. The arrangement of the top works can be seen very plainly in Mr. Morris's excellent photograph, and the sizes of the tanks, cab, and other adornments can easily be gauged from the actual job when the boiler has been mounted on the frames. The photo. also shows the various "trimmings." Note that, as the height of the running boards or platforms is less than normal, the buffers have to be mounted higher than the centre of the beam, in order to meet those on the carriages at the right level.

A  $3\frac{1}{2}$ -in. gauge "Terrier" built to the above dimensions, given average workmanship, would run away with a single adult passenger, with the lever in the next notch to middle, much the same as *Stepney* and her sisters ran away with the seven "cattle-boxes" in the East London set trains; and so long as you kept a wary eye on the water gauge (the little boiler does not hold much water) and could use the shovel intelligently, she would not shy at three or even four passengers. It seems like "cruelty to animals" to expect a little engine to work like that; but the "shed pilots" or yard engines at New Cross, Battersea and Brighton often used to shift a whole road of "dead" tender engines, five or six of them at once, as a matter of course.

Apart from the 400 odd tons of dead weight, the friction of the moving parts in a "cold" engine is very considerable, the oil making everything kind of sticky instead of free; and the comparative tractive effort of a full-size "Terrier" doing that job, and a little sister with "four up" on  $3\frac{1}{2}$ -in. gauge, is very much in favour of the latter. The great drawback with a little tank engine on live passenger hauling, especially on a continuous road, is getting

at the firehole to do the firing properly. Personally, it gives me the proverbial "pain in the neck" to see an engine running minus cab roof and other parts, but unfortunately on a tank engine it is very difficult to avoid. For the little "Terrier," I would suggest making the cab roof and back as one unit, and attaching a couple of slides or runners to the insides of the side sheets forming the cab and bunker sides. As the top of the bunker is low, the roof and back could then be lifted right out, and there would be ample room to get at the firehole, regulator, lever and other handles, when the engine was running.

An alternative arrangement, which I fitted to a rebuild job some years ago, might also be adopted. This consisted in making the back of the cab in two parts, the joint line being just a fraction below bunker level. The lower part was made a fixture, but the upper part was attached to the cab roof, as mentioned above. The cab roof itself was hinged to the weatherboard, or cab front; and when it was required to fire the engine, or operate any of the handles, the back of the cab roof was lifted, and opened on its hinges like the lid of a box, resting on the dome, and taking the upper half of the back sheet of the cab with it. After firing, or "twiddling the knobs," the whole doings was simply shut again, the opening and shutting taking only a fraction of a second, naturally. The steam gauge could be seen through one rear cab window, and the water gauge through the other, so that there was no need to keep the top open all the time.

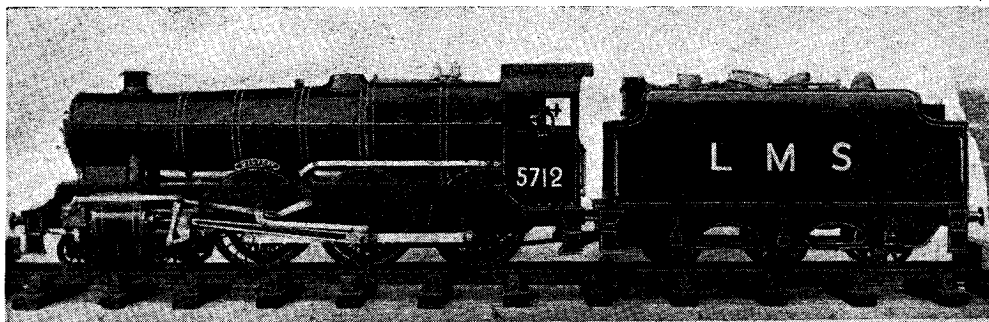
It would, of course, be quite feasible to use oil firing on a  $3\frac{1}{2}$ -in. gauge "Terrier," with the tool-box pressed into service, in addition to the bunker space, for carrying a supply of fuel; but this would work best with a water-tube boiler, and somehow I can't fancy a Brighton "Router" with a boiler of that description. Seems like sacrilege! However, some may prefer it on

the score of easy construction and economy of material; and if anybody should build one, the best type of burner to use would be my improved Carson type, using paraffin as fuel. But oh, please, "Curly" implores you not to disgrace his own little darling by cutting a slot in the cab roof and bringing the regulator handle through it—that is "toyshop practice" indeed!

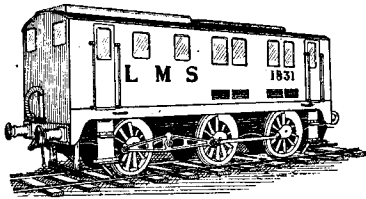
One thing I forgot to mention was the lubrication. As you can see from the picture, *Stepney* herself had a displacement lubricator on the side of the smokebox, with a regulating valve worked from the cab, the rod passing through the handrail; and this was supplemented by a couple of little "dope cups" on the front of the smokebox. This arrangement would not be sufficient for the  $3\frac{1}{2}$ -in. gauge engine; Nature won't be "scaled," and the bearing surfaces of the little engine need just as much oil as those of the full-sized article. Therefore, a mechanical lubricator should be made up similar to those I have described for  $2\frac{1}{2}$ -in. gauge engines—this size is plenty big enough—and installed in the usual position behind the buffer beam, in front of the cylinders. With the cylinders at the spacing given above there is room for a fifth eccentric on the crank axle, and the drive could be taken from that, *via* a stout cycle spoke, to the ratchet lever of the lubricator; alternatively, a connection could be made to one of the valve-gear eccentrics, though I don't care much for the idea of loading one more than the others.

Another way would be to prolong the valve spindles right through the steam chest, using two more glands in the front of it, and take the drive direct from one of them by means of a pin working in a slotted lever.

What would a full-sized "Terrier" have done, using superheated steam, mechanical lubrication, long-travel piston-valves, and other "tried and proved" refinements? I can assure you that what's left of poor "Curly" would just love to try!



Mr. J. G. Tindall's  $3\frac{1}{2}$ -in. gauge L.M.S.R. "5XP" class 3-cylinder locomotive, No. 5712, "Victory."



★ EDGAR T. WESTBURY'S

**1831**

## The Transmission System

IN the introductory notes at the beginning of this series of articles, I remarked on the inherent problem of transmitting the power of an I.C. engine to the track wheels, which still constitutes one of the greatest practical difficulties in the design of full-sized locomotives of this type, and is by no means eliminated or reduced in the case of the model. My statement that the transmission system might well be considered to be the Achilles' heel of every scheme for applying the power of an I.C. engine to this purpose, seems to have been seized upon avidly by some of the expert critics, and construed as an admission that I have encountered some real snags in this part of the design. But recognition of the fact that a serious problem exists is by no means the same thing as a confession of failure to cope with it; on the contrary, the more serious the problem, the greater the incentive to get down to it and find a solution. If there were no problems in engineering, there would be no need for engineers, any more than doctors would be required if there were no diseases, or lawyers if there were no legal disputes.

Some of my critics appear to have taken the attitude—perhaps unconsciously—that there is something almost improper in the idea of model engineers tackling any proposition which is outside or ahead of convention or precedent in accepted engineering practice. If this indeed is true, or if it is an established tenet among model engineers, then I must openly confess to being an arrant Philistine, because I have always taken the very opposite point of view. I regard the model as father of the prototype (the terminological pedants will undoubtedly be able to split hairs over the literal meaning of the respective terms, but most readers will understand what I mean), and consider that model engineers can and should be pioneers of engineering design, rather than mere followers of a beaten track.

Be that as it may, however, I have certainly followed up my own convictions in dealing with the problems encountered in the transmission system for "1831," and the

result, while far removed from anything which has ever been used for this purpose in a full-sized locomotive, follows quite sound mechanical principles, and can be relied upon to fulfil its intended purpose. The latter conclusion is not based solely upon "paper evidence," as a good deal of actual experimental work has been done in investigating the principles of torque transmission and conversion adopted, and additional proof of their practical effectiveness is provided by the success of the experimental locomotive built by Mr. Ripper, which was described in the issue of the "M.E." dated June 19th, 1941, not to mention the many finished examples of the "M.E." Aveling type model road roller which are now completed and working satisfactorily.

### Variable-speed Friction Drive

The principles of this method of transmission, which constitutes one of the simplest methods of providing a range of torque/velocity ratios in both directions, from a source of power of unidirectional rotation, with very limited speed and torque range, were fully described in the articles dealing with the before-mentioned road roller. While exactly the same principles are utilised in the present case, the design has been modified and re-arranged to suit the conditions of duty and method of installation, and also to handle increased power and torque.

Needless to say, my choice of this method has not been allowed to pass without a certain amount of criticism—nearly all of which, I may add, has been entirely destructive, and unaccompanied by any really practical suggestions for a more efficient or satisfactory method—and most of my critics have stressed the fact that in nearly all cases where somewhat similar systems have been employed in full-sized practice, they have eventually been abandoned in favour of more conventional change-speed gearboxes.

It is frankly admitted that this is at least true in the case of the application of the principle to automobile transmission, but the inference that it is thereby proved to be inherently unsatisfactory is not necessarily a logical one. In engineering industry and commercial production, the fate of

\* Continued from page 431, "M.E.," April 30, 1942.

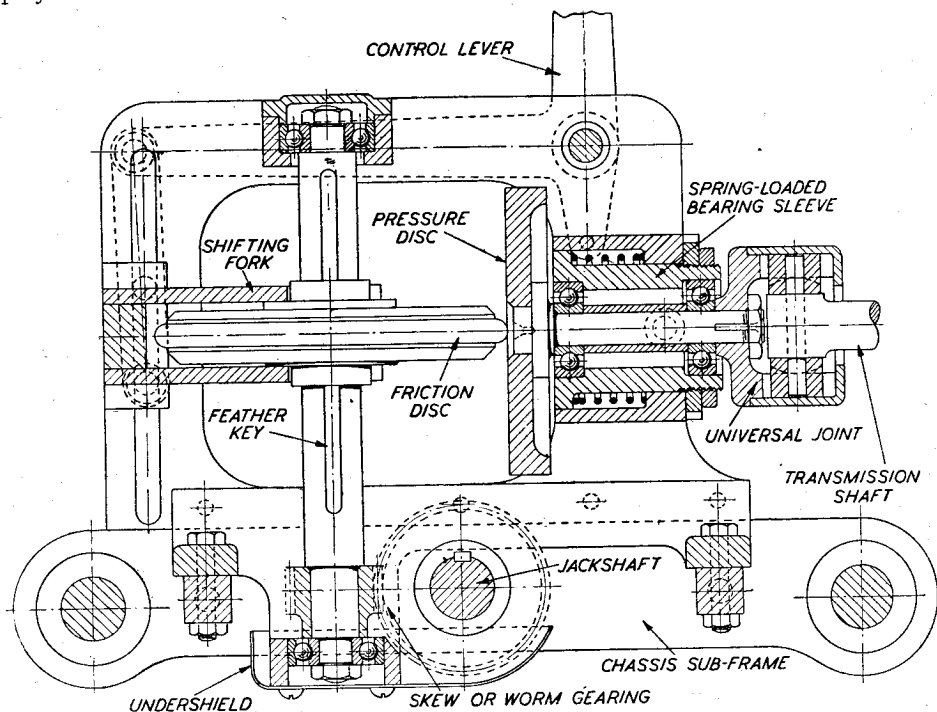
mechanical principles and designs is often decided by other factors than those which arise from pure engineering ethics. The availability of a ready-made component will often induce a manufacturer to abandon his own product, however ingenious or efficient it may be, and this tendency has been very prevalent in motorcar production, particularly in respect of such items as ignition equipment, carburettors and transmission gear.

Speaking from some experience with a system of friction transmission which was employed on a well-known light car some

Incidentally, another interesting sidelight on the subject of this particular gear is that the car to which it was fitted was manufactured on the site where the "M.E." is now printed and published.

#### Layout of Transmission Gear

The two drawings of the transmission gear for "1831," Figs. 108 and 109, should explain its operation and control quite clearly. The first of these is a sectional elevation on the longitudinal centre line, which shows the main working parts, and the second is an external view on the offside,



**Fig. 108. Longitudinal section of transmission gear complete on sub-frame mounting, on centre line of chassis. (One-third full size.)**

years ago, it is my firm conviction that its most serious limitation was its inability to stand up to the abuse imposed by the unintelligent driver, rather than any inherent mechanical fault or inefficiency. Many users of this gear who were prepared to acquire a sound understanding of its operation, and to handle it properly, spoke very highly of its performance. I believe I am correct in stating that one of the pioneers concerned in the development of this gear is at present a well-known and very active figure in the model engineering world. Not having the pleasure of his intimate personal acquaintance, I have not been able to discuss the matter with him, but I feel sure that he could tell us quite a lot about it if he chose to do so.

showing the control gear. A complete general arrangement has not been provided, simply because the disposition of the various parts, when viewed in plan or end elevation, appears as a crowded mass of details which would rather confuse than clarify the layout. All the parts will, of course, be shown in detail in subsequent drawings.

It will be seen from Fig. 108 that the transmission gear is housed in a frame which is mounted on the top of the chassis sub-frame, and might indeed have been built integral with the latter, except that considerations of accessibility have made it desirable to provide for easy detachment of the gear without disturbing the sub-frame, which must be more or less permanently assembled in the main chassis. The transmission frame

embodies a fairly massive base bolster, secured to the sub-frame cross members by four bolts, and side plates which lie flush with the vertical sides of the sub-frame, and carry housings for the bearings of the horizontal and vertical shafts.

### Method of Coupling

The drive is transmitted from the engine to the horizontal shaft of the transmission gear by means of a short shaft (only the broken end of which is seen in this figure) which engages with a universal joint at either end, by means of which the relative displacement of the positions of driving and driven members, caused by the motion of the track axles on their springs, can be allowed for, or slight errors in the initial alignment of the shafts compensated. It will be noted that the form of joint adopted is that known as the Cardan type, which comprises a cross pin equipped with die blocks, working in the slotted jaws of a cylindrical coupling. This type of joint can readily be enclosed and lubricated, and is also rather more easily constructed than most other types of universal joints, including the well-known Hooke's coupling. An attempt has been made to utilise ready-made components for this purpose; in particular, one having a rubber block insert has been tried out, but is not so satisfactory as that shown herewith. Rubber and fabric joints look very simple, and have the obvious merit of complete silence in action, but one of their faults when used with small, high-speed shafts, is that they are liable to run out of balance, either through errors in initial adjustment or uneven distortion under torque load.

The Cardan type of joint also has the merit of providing latitude in an endwise direction so as to allow for telescoping or "pumping" motion which may take place in a drive of this nature.

### Primary Shaft

The horizontal shaft runs in ball-bearings in a cylindrical sleeve or "quill" which is pressed inwards (towards the centre of the transmission frame) by a moderately powerful spring, but motion in this direction is limited by means of adjustable screwed collars or lock-nuts on the outer end of the sleeve. At the inner end of the shaft is mounted a flat-faced steel disc with a recessed centre, which constitutes the primary driving member of the transmission system. For the benefit of those readers who have had no previous acquaintance with this type of gear, and seek an explanation of its mode of operation, it is suggested that this disc should be regarded as rotating in one direction at a constant speed; though the latter is not

strictly true in the present case, it will assist the explanation to consider it as such.

### Friction Disc

Mounted on a shaft at right-angles to the primary shaft, and capable of being moved endwise thereon, is a second disc, the outer edge of which is faced with a material which provides a frictional grip. In the drawing, this disc is shown in mid position, that is, opposite the exact centre of the pressure disc, and by reason of the recess in the latter, out of contact with it, the lock-nuts on the sleeve being suitably adjusted to ensure this. If, however, the disc is moved either way, it will make contact with the face of the disc as soon as it moves beyond the radius of the recess. In actual fact the pressure disc will be very slightly displaced endwise when this takes place, so that the surfaces are then pressed together by the loading spring. In this way, motion is transmitted by friction, the direction of rotation of the friction disc depending on which way it is moved, and the relative speed on the *peripheral* or surface speed of the part of the pressure disc with which it engages.

Thus it will be seen that by setting the friction disc in the mid position, the drive is "neutral"; moving it one way provides one direction of rotation (which may be defined as "ahead"), and the other way causes it to move in the opposite direction ("reverse"); while the farther out from the centre it is moved, the higher is the gear ratio of the driven disc.

In the "M.E." Road Roller, the shaft carrying the friction gear was mounted horizontally and in line with the fore-and-aft centre of the chassis; Mr. Ripper's locomotive also has the shaft horizontal, but across the chassis. But as will be seen from this drawing, a vertical shaft is employed in the present case, simply because this disposition has been considered most convenient in relation to other components of the system, and also to enable the control gear to be arranged simply and efficiently.

### Shifting Gear

The friction gear is arranged to drive the vertical shaft positively through a feather key, which enables it to be moved endwise quite freely. This motion is effected by forked plates which project horizontally above and below the boss of the disc, and are attached to a vertical sliding frame which extends across the transmission frame between the two side plates, and works in vertical slots in the latter. Pivot pins are fitted to the sliding frame, which project through the slots, and are connected by links to the horizontal arms of bell crank levers fitted at either side of the transmission frame.



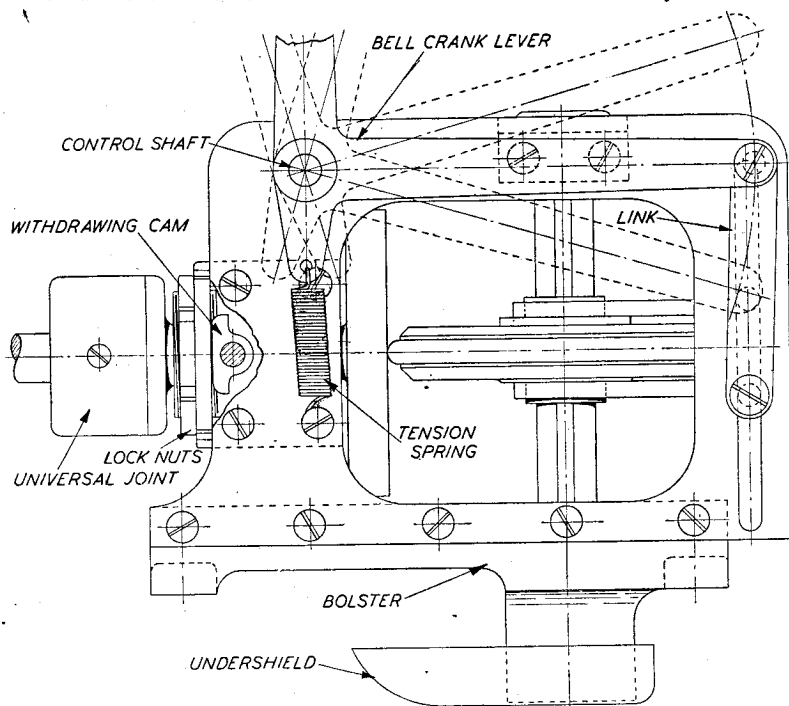
Fig. 109 shows the external arrangement of one of these levers, which, it should be noted, is duplicated on the other side, together with the link. The upward extension of the lever is suitably connected to a manual control lever in the driver's cab of the locomotive. It will be noted that a tension spring is attached to the lower extension of the lever, in order to centre the disc automatically when the lever is released. The springs are arranged slightly off the vertical centre to compensate for the weight of the horizontal arms of the levers.

#### Withdrawal Gear

Under normal conditions of working, nothing in the nature of a release clutch is

ality, a means has been provided of manually disengaging the two discs, thus enabling the friction disc to drop back to the neutral position.

The withdrawal gear comprises a shaft fitted to the offside of the transmission frame, carrying a cam which is located behind the adjusting nuts of the primary shaft bearing sleeve. In Fig. 109 the frame plate and housing are shown broken away to disclose this cam, the flat side of which is normally flush with, or slightly below, the surface of the housing; but when the shaft on which it is mounted is turned either way (the means of doing this are not shown, but do not require explanation at this stage) the nut is forced away from the housing,



**Fig. 109. Offside view of transmission gear, detached from sub-frame.**  
(One-third full size.)

required for the purpose of disconnecting the drive when "changing gear." Steady pressure on the bell crank levers when the engine is running normally will cause the friction disc to "climb" smoothly from neutral to low gear, and progressively to high gear; releasing the lever will enable it to drop back into neutral equally smoothly. But occasions may arise where the sudden stoppage of the locomotive may take place while the drive is still engaged. In such circumstances, re-starting under power may prove somewhat difficult, as the engine would have to take the load on an unfairly high gear ratio. To cope with this event-

against the action of the sleeve loading spring. Obviously, the sleeve, shaft and pressure disc will also be drawn back, and the loading on the friction disc relaxed.

A careful driver may never require to use the withdrawal lever at all, but it will nevertheless be worth while as an emergency control, and may also be found useful to relieve unnecessary frictional drag on the gear when the locomotive is coasting.

#### Final Drive

The vertical shaft, which carries the friction disc, transmits motion to the

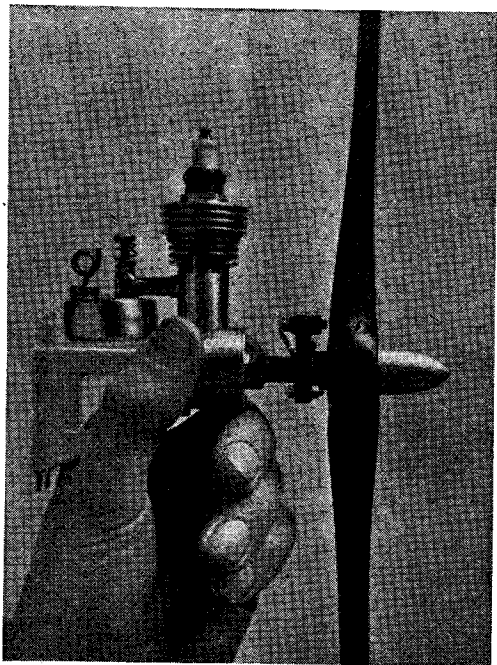
(Continued on page 467)

## A Small Two-stroke Aero-Engine

By M. W. SYDENHAM

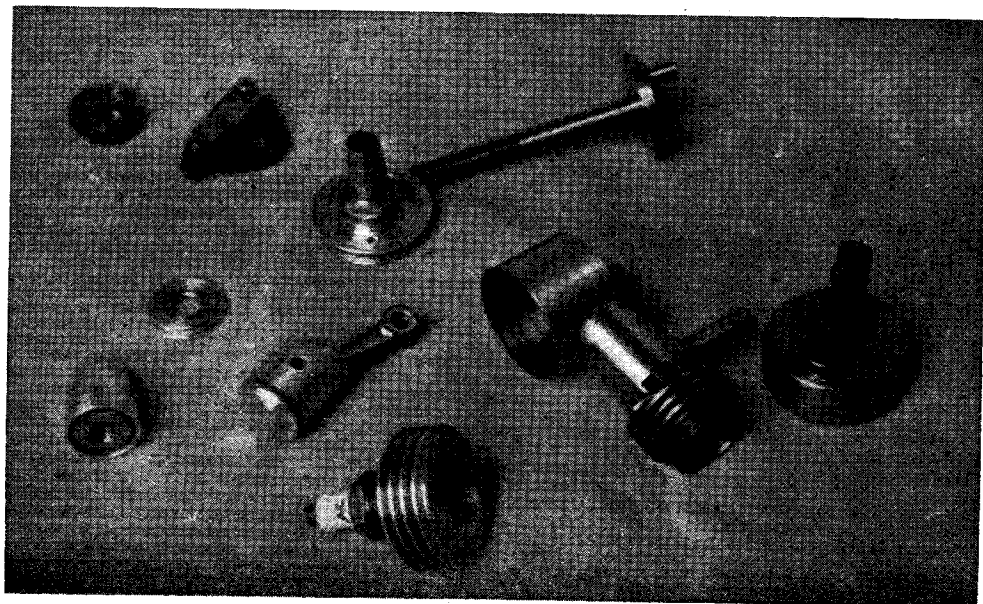
THE term aero-engine is perhaps not quite justified, as the engine has never flown a 'plane. However, it was intended for this purpose, and when peace days return, perhaps it will be able to prove itself. There are no very unusual features about the engine, at least not intentional ones. I do wish that this effort had not reached completion before Mr. Westbury's very excellent series of articles on the 2-stroke engine had started, as so many improvements could have been made. However, perhaps the photographs and description may be of some interest.

The bore and stroke are  $\frac{5}{8}$  in., giving a capacity of 3.14 c.c. The cylinder and crankcase are turned from mild steel, left as thin as possible and, with the transfer passage and induction pipe, are brazed together. The cylinder-head, crankcase cover and piston are machined from dural. bar, the latter is fitted with one cast iron ring. A hardened steel bush is fitted to the crankcase cover and the crankshaft journal is hardened. This hardened plain journal



The engine on its aluminium mounting. The odd-shaped spinner covers a starter dog.

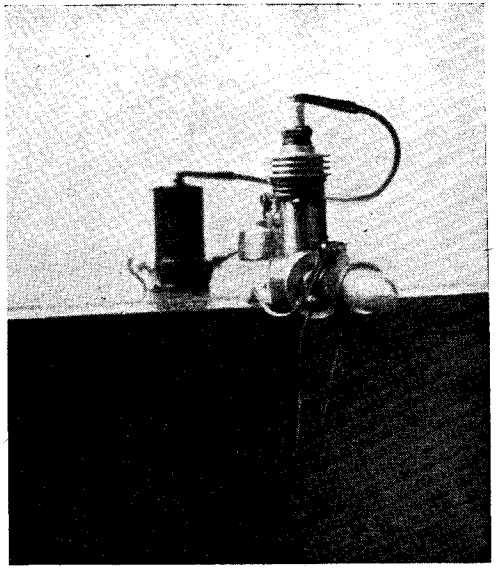
bearing proved so satisfactory that both the big and small-end bearings have been fitted with hardened steel bushes, the crank-pin and gudgeon-pin have also been hardened.



The extreme simplicity of this type of engine is shown by this view of the parts.

When finished, great trouble was found in starting. This was due to too much leak past the piston. In engines of this size it seems surprising what a very fine piston fit is required before sufficient compression pressure is obtained. Increasing the proportion of lubricating oil in the petrol helped considerably by improving the sealing properties of the mixture, but a second piston had to be made before easy starting was obtained. The performance of the engine has not come up to first hopes. The power developed is very small, the best so far is 0.05 h.p. at 5,000 r.p.m. The apparatus used in obtaining this figure was very crude, so that the result is only approximate. At higher revs. the b.h.p. decreased; this was almost certainly due to contact-breaker trouble. The spring contact-blade was far too weak and the cam operating it very violent in its action, so that very doubtful timing resulted.

The weight of the engine alone is  $3\frac{1}{2}$  oz., but the weight of the complete plant, battery, coil, condenser, etc., is 12 oz. This gives 4.38 lb. b.h.p. for the engine and 15 lb./b.h.p. for the complete plant. Probably these figures are of very little use, but



Running with a 12-in. diameter propeller.

when opportunity arises I hope to carry out a few more tests with greater accuracy.

## “1831”

(Continued from page 465)

jackshaft by means of a skew or worm gear, reference to which has already been made. It may be mentioned that this gearing has been the source of quite a lot of worry, as nothing of a suitable nature is available ready-made, and attempts to get it made, under present conditions, have been entirely unsuccessful. The particular form of gearing is by no means easy to produce in the home workshop, at least with the usual equipment available to the amateur.

In the circumstances, there was a distinct risk that the attractiveness of the entire locomotive design might have been very seriously affected, in the eyes of potential constructors, by the difficulty of obtaining or producing this gear. One might, perhaps, have been justified in leaving the problem over until more favourable conditions prevail in the model supply trade, but I have a distinct aversion to leaving loose ends in such matters, especially as there are several readers who do not wish to wait for an indefinite period before getting on with the job. I have therefore considered it desirable

to tackle the problem of producing suitable gearing by means and equipment which are well within the capacity of most model engineers. This has proved to be a rather tough proposition, but I am happy to say that, aided by the advice and co-operation of some of my colleagues in the model engineering fraternity, I have evolved a method, and a comparatively simple lathe attachment, by means of which a completely satisfactory result can be produced. This will be fully described in the following instructions for machining the components of the transmission gear.

It will be seen that the two gears in the final drive are arranged so that mesh adjustment is possible, and the detachment of the entire transmission frame, with its essential parts, from the loco. chassis, is not interfered with. A small pan or undershield is attached to the underside of the vertical shaft bearing to prevent lubricant dripping from the gears or prevent grit getting into them; it is only necessary to detach this undershield and remove the four bolts through the cross members, in order to enable the complete assembly to be lifted off the sub-frame.

(To be continued)

## Model Aeronautics

# An Early "Wright" Biplane

AMONG my varied collection of books, accumulated over a period of years from many sources, I have an up-to-date "Dictionary of Famous People." From it I may learn something of the biographies of modern band leaders; or that Jonathan Wild was a notorious English burglar, hanged, fortunately, in 1725; or that Peg Woffington was a celebrated Irish actress, who took her final bow from the world in A.D. 1760. But there is no mention of Orville and Wilbur Wright, the inventors of the first successful aeroplane. Well! Well! The interests of the world are varied, and, I suppose, it is not to be expected that two men of quiet genius and courage should figure in such a gallery of fame.

Be that as it may, it is certain that of all the countless workers in scientific fields, few have so changed the outlook and destiny of mankind as these two bicycle makers from Dayton, Ohio, in the United States of America.

Their early life seems unmarked by any event significant to their later achievements, for they seem not to have been attracted to the subject of aeronautics until the publication of some of the results of the experiments of Otto Lilienthal, at the time of his death in 1896. After this date we find the Wrights in correspondence with Octave Chanute, himself a well-known experimenter with gliders, leading to similar investigations with models by the Wrights themselves.

### The Problem of Human Flight

During the years 1900 and 1901 the brothers experimented with kite-like gliders, and succeeded in making some flights upon them, after which they seem to have seriously settled down to solving the problem of human flight. With the quiet thoroughness which characterised all their actions they devoted two years to the study and testing of almost all the scientific formula at that time current relating to the problem of heavier-than-air aeronautics, and, after disproving almost every formula set down in the scientific works, they devoted their energies to pure experiment, to discover, along their own lines, what was the true state of affairs.

With a care, thoroughness and restraint that few other men have displayed, they gradually improved their knowledge, and consequently their machines, and after long experiment with man-carrying gliders, the outlines of the design for their power-driven aeroplane took form.

About this period they removed to the sand dunes of Kitty Hawk, N. Carolina, because of the solitude, and the winds which blew more steadily here than at any other part of the United States.

By now they were in communication with some of the pioneers in France, and, in this connection, it is characteristic that the Wrights communicated with this band of enthusiasts for six months on the subject of propellers alone—after which they started to design their own airscrews.

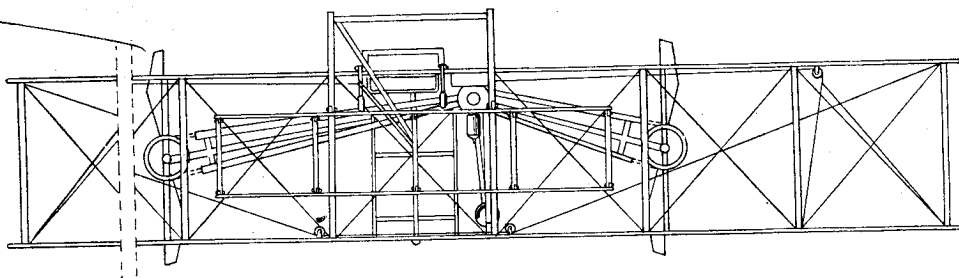
In December, 1903, their power-driven aeroplane was completed, and, what was more important still, the Wrights were both competent pilots, skilled in the management of machines in the air, due to their training with gliders. Thus, after so long a preparation, Orville Wright, on December 17th, 1903, made the first successful flight by man with a power-driven machine. Four flights were made that day, the longest being 852 ft. in 59 sec.

### A First Flight

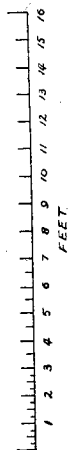
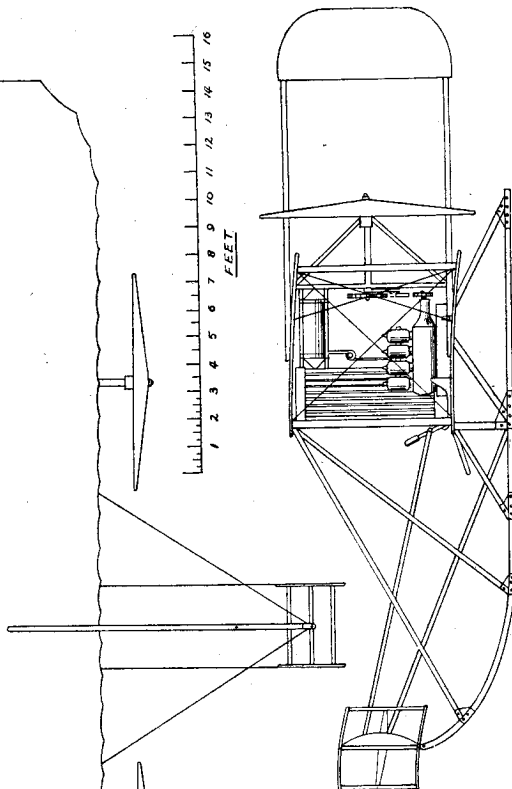
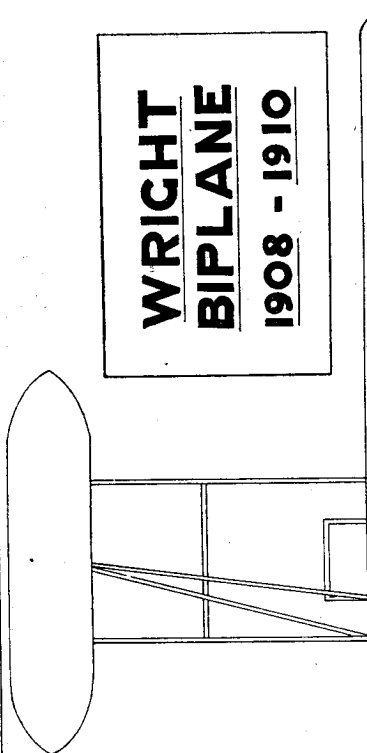
Several local people had been invited to see these attempts, but the morning of December 17th dawned cold and windy, and only five of them arrived. The brothers drew lots as to who should be the first to attempt the flights; Orville was the winner, and thus achieved the unique distinction of being the first man to fly successfully in a heavier-than-air, power-driven machine. In spite of the inclement weather, the flights were made with simple efficiency, the machine rising smoothly from its launching apparatus, and sinking quietly to earth at the end of the flights. So, in this secluded corner of the world, while mankind pursued its humdrum occupations, a new page was turned in the book of history.

Unfortunately, a sudden gust of wind overturned the Wright machine when on the ground, whereby it was so badly damaged that its repair was considered impracticable.

**Our contributor, Mr. Lawrence H. Sparey, commences the description of how to build a solid, scale, working model**



**WRIGHT  
BIPLANE  
1908 - 1910**



The brothers, therefore, decided to build an entirely new aeroplane, containing improvements suggested by the day's experience. From this time onwards the Wrights seem to have progressed with uncanny rapidity, working quietly and without publicity, attaining, almost unknown to the outside world, flights extending to miles. It seems almost unbelievable that these events attracted so little attention at the time. An unfortunate experience with the Press, and the confusion which existed in the lay mind between the flights of lighter-than-air craft

the Smithsonian Institute, who was building a man-carrying version of his successful model aeroplane; which, coming to nothing, seems to have satisfied the official mind on the impracticability of flying machines. These negotiations by the Wright brothers tended to make their experiments more and more secret; furthermore, they themselves were not given to much talk or boasting. Nothing so much illustrates the characters of these two men as a remark made some years after by Wilbur Wright, when taxed upon the matter of why they said so little

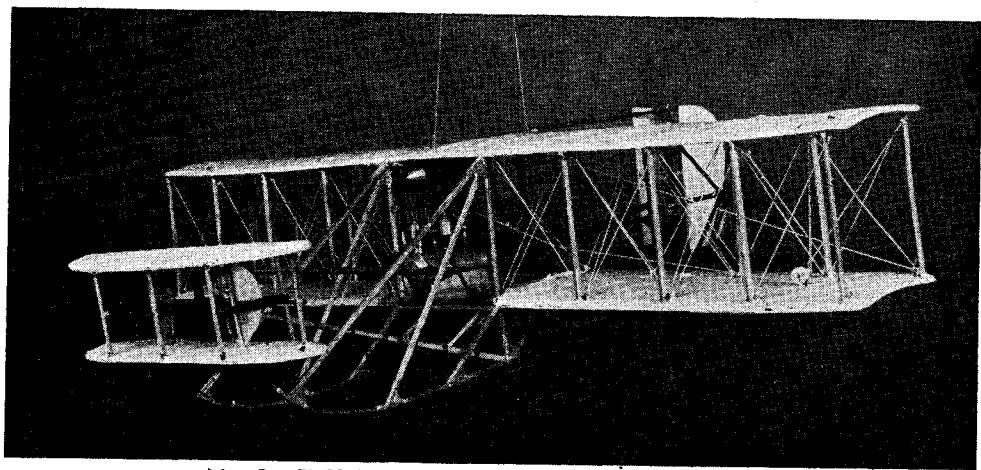


Fig. 2. Half front view of the model Wright biplane.

(such as balloons) and the quite different heavier-than-air machine, seems to have contributed to this neglect. In fact, so little was known of the achievements of these two mechanics on the lonely sand dunes of North Carolina, that a letter written by Wilbur Wright, in 1905, to his friend P. Y. Alexander, of the British Aeronautical Society, wherein Wilbur calmly stated that his aeroplane was making flights of 24 miles, came as an unbelievable shock to European experimenters. Many frankly disbelieved the statements, but others, who were better acquainted with the characters of the brothers, could do nothing but believe the seemingly impossible.

At this period, the Wrights seem to have realised the vast political and commercial value of their invention, and were in touch with the French government, who sent a representative over to the U.S.A. with a view to negotiations. Through a misunderstanding these came to nothing. A similar fate befell an approach to the British War Office, who flatly stated, in official terms, that they were not interested in manufacturers of aeroplanes. The U.S.A. government was, at the time, financing experiments conducted by Prof. Langley, of

of the wonderful work which they were doing. "If I talked a lot," said he, "I should be like the parrot, which is a bird that speaks most and flies least."

The subsequent progress of the Wright biplane now becomes so international and mixed with the achievements of other pioneers, as to really constitute a history of flying, a matter which cannot, naturally, be handled here. Progress may be gauged, however, by a statement of the flights which were performed by the Wright biplane during the years leading to the 1908 to 1910 period, with which our present model is concerned. Starting with a distance of 852 ft. in 1903, by 1904 Wilbur Wright had flown 3 miles in  $4\frac{1}{2}$  min., while the following year a greatest distance of 24 miles had been attained! During the next two years little flying seems to have been done by the Wrights, who devoted themselves more to the building and perfecting of their aeroplane, but by 1908 they were again in the air, and astounding the aeronautical world with flights culminating in a magnificent  $76\frac{1}{2}$  miles flight in December of that year. It must be remembered that the longest flight made by any other machine at that period was 17 miles, made by Farman with

his biplane at Chalons, France, an achievement far in advance of that of any other European aeronaut.

This year of 1908 brings us to the Wright biplane of which our model is a representation, and the machine is certainly worthy of a little study. Looked at objectively, and forgetting the aeronautical wisdom which the years have given us, the machine is certainly a logical and straightforward attempt at a flying machine. In some measure, it approaches the aeronautical ideal—the “flying wing.” Looking at our picture of the model in Fig. 2, we may see that we have here, as the principal construction, a biplane wing, in the centre of which is fixed the engine, pilot's seat and controls. The two propellers are fixed to the trailing edge of this wing, whilst a rudder at the rear, and an elevator at the front, provide the minimum of accessories necessary to control the flight of the machine.

The actual details of construction may be left to be dealt with later as the building of the model is described, but for the moment it will be advisable to indicate some typical features of the Wright biplane.

The early experimenters with aeroplanes seem to have been divided into two schools.

was air borne. Foremost, and the most important of the Wright patents, was the system of lateral control of the aeroplane provided by the warping of the wing tips by control wires passing through pulleys to the control lever at the pilot's side. Any tendency for the machine to dip sideways was corrected by warping the wing tips of the depressed wing downwards, thus increasing the angle of attack of that wing, and increasing the lift. This principle was, some years later, the subject of protracted proceedings concerning the priority of the invention, the Wrights' claim being contested by Curtiss (now, strangely enough, combined with his opponent in the great Curtiss-Wright Aeroplane Company of America) and others. Whatever legal quibbles may have transpired, the fact remains that the Wrights were flying for miles with a machine embodying this principle years before their rivals were even hopping for a few yards off the ground.

Longitudinal stability, that is, the control of the machine during nose dives and the prevention of stalling, was attained by the use of a twin-plane elevator, set well forward of the main plane on two outriggers, which also formed the landing skids of the machine. Normally, the two elevator planes formed,

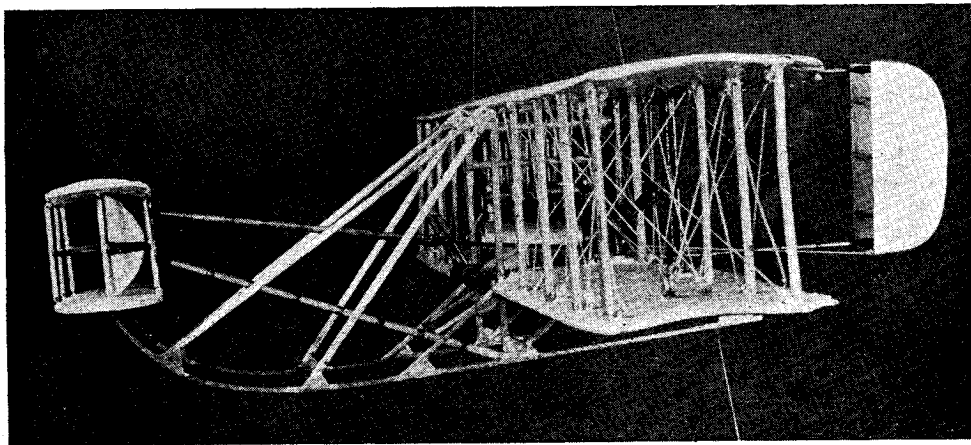


Fig. 3. The model as seen from the side.

There were those who considered that it was only necessary to build a machine capable of flight for success to be achieved, and those who thought that while the flying capabilities of the machine, that is, the actual ability of the machine to rise from the ground, were vastly important, first place must be given to the controllability of the machine in the air. To this latter school the Wrights belonged, and their belief is well reflected in the ample provision for control in all directions when the machine

with their side supports, a rectangle (as may be seen in Fig. 3), which was capable of being distorted into a parallelogram, thus altering the angle of attack of the two planes. Small stabilising fins were fitted between the planes.

Directional control was achieved by means of a twin rudder, actuated by wires connected to a rudder bar, and from thence to a control lever by the pilot's seat. In some later Wright machines the elevator system was transferred to the rear of the machine,

a single plane taking the place of the two planes; the twin rudder was, however, retained.

Most noticeable feature of the Wright biplane was the skids which did duty for the more usual wheeled undercarriage. This was, soon after 1910, replaced by the more usual arrangement, but the actual machine under consideration at the moment had the skid undercarriage. Although possessing a decided aerodynamical advantage, the skid arrangement was a great handicap, especially in competition with other, wheeled aeroplanes, in so far as the Wright machine could only be launched from a special launching apparatus, and was helpless if forced to land at a distance from the launching station. In passing, it may be remarked that the launching apparatus consisted of a wooden tower, from the centre of which a heavy weight was suspended by a rope. The free end of this rope was led, by a system of pulleys, to ground level, and from thence to the ends of two launching rails, passed over another pulley, and back to the foot of the tower. The skids of the biplane were placed upon the launching rails, and the end of the rope attached to the machine, when, by releasing the weight, and assisted by the pull of the propellers, the machine was catapulted into the air. It is interesting to note that a similar system of launching had been advocated as long ago as 1846, by Henson, the British aeroplane experimenter. Many years later, Wilbur Wright acknowledged his great debt to this pioneer for much of the inspiration embodied in his machine.

### Power

Two twin-bladed propellers of 8 ft. in diameter were rotated at a speed of 450 r.p.m. by a petrol engine of 25 h.p. These engines differed greatly in the various biplanes built, but all were of the water-cooled type, and having four cylinders. The airscrews were connected to the power unit by means of ordinary bicycle chain, running through guides of bicycle tubing. As might be expected from their early connection with the bicycle trade, much of the aeroplane followed cycle construction, cycle lugs and tubing being freely used. The gear wheels which drove the propeller shafts were, in fact, ordinary standard cycle chainwheels. This, in part, accounts for the rather flimsy appearance of the machine.

About this period, several independent firms (notably the now famous Short Brothers of flying boat fame) were building Wright biplanes under licence, and this gave rise to several divergent types, all, however, following the prototype in main essentials. Smaller differences were embodied, such as

a varying shape of the elevator outriggers, a difference in the number of main plane struts, and so on. It will be noted that my model has ten pairs of main wing struts, whilst the drawing shows only eight pairs. The reason for this is that as the top plane of the model is only butt glued to the ends of the spars, I was afraid that the model would be too flimsy if only eight struts were used, so I chose a ten-strut prototype. On completing the model, however, I find that it is amply strong enough, and that the more usual eight-strut type may be safely used. My description will, therefore, deal with this type, as all other particulars are the same.

### A Few "Don'ts"

In building the model I have followed some dictates which long experience has taught me. Scale model building is a tricky business, the chief difficulty being to get small scale parts to look "right." I have thus formed a set of "don'ts," which may be summarised as follows:—

Don't use aluminium paint.

Don't use wood to duplicate metal parts unless absolutely unavoidable. Use metal.

Don't use black paint unless the prototype specifically calls for it.

Don't dodge intricate parts because they are difficult. (The tiny movable joints on the Wright elevator will give you something to think about.)

Don't forget that the builders of the real machines are always extremely neat workmen.

I may say that the model Wright biplane, if built well, is really a museum piece. Although not a flying model (the necessary alterations would have destroyed the character of the machine) it is a working model; that is, all controls are operated in the correct manner from the pilot's seat.

(To be continued)

## Blackening Steel

First make up the following two solutions:

- (a) Sodium hyposulphite  $4\frac{1}{2}$  oz., water 40 oz.
  - (b) Lead acetate  $1\frac{1}{2}$  oz., water 40 oz.
- Clean the articles in caustic soda to get rid of all traces of grease, warm them, and brush with a mixture of equal parts of A and B. It is necessary to boil this mixture before use. After allowing to dry in a warm place, polish with Boiled linseed oil.—W. F. COMERFORD.



# A CALENDAR —

For the years A.D. 1 to A.D. 2099

By T. P. STUCHFIELD

I WAS much interested in the "Perpetual Calendar" described in a recent issue of the "M.E.", but do not at all agree with the title "Perpetual"; "Adjustable," if you like, but not by any means "Perpetual"; it will not, for instance, tell you that the 2nd of Sept., 1666, was a Sunday, which a perpetual calendar should do.

I have made about 14 calendars on the lines of the drawings and description below that are capable of giving the days of the month and week for all years from A.D. 1 to A.D. 2099 inclusive.

The calendar consists of four main parts :

- (1) A half cover marked with the days of the month and having a long narrow slot through which the days of the week and a short slot through which the hundreds of the year are seen.
- (2) A half cover marked with the months and having a wide slot through which the tens and units of the years are seen.
- (3) A rotating disc marked with the days of the week and having 35 teeth on the edge.
- (4) A rotating disc marked with the tens and units of the year, also having 35 teeth.
- (5) A thin leather washer between 3 and 4 to cause a small amount of friction between these two discs.

Covers 1 and 2 are made from blacking tins, a strip of tin is soldered to the inside of 2 (or 1) to form a rebate over which 1 (or 2) fits, it also serves to bring the edges of 1 and 2 into better co-incidence; cover 2 is also fitted with a fixed centre bolt, the nut of which serves to adjust the friction between discs 3 and 4.

The finger slots at the edges are cut *after* the viewing slots have been cut and the two half covers satisfactorily fitted together; of course, the viewing slots in 1 and 2 must be exactly opposite each other.

The rotating discs 3 and 4, of brass, are exactly alike as regards the shape, each has a thickening washer soldered to the centre, thus forming a recess into which the scales are pasted; the edges of each disc have 35 teeth, which are turned up as shown, and these teeth must register correctly with each other and with the scales on the discs; these teeth enable the discs to be rotated by the finger through the side slots in the covers.

The metal work should be enamelled before the scales are pasted on.

The scales are marked out on good quality drawing paper and are better if varnished with a clear varnish after fixing in position; it is obvious that they must be set in correct register, back and front.

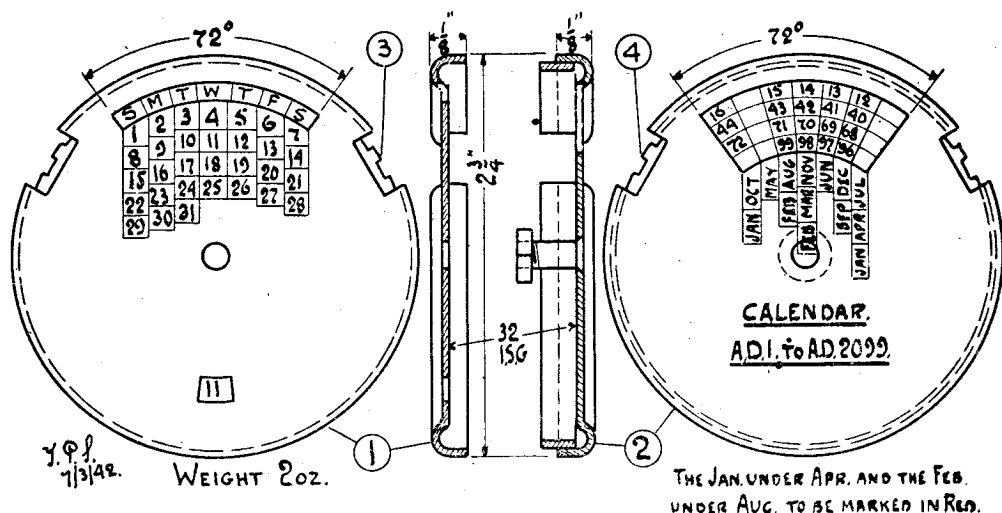


Fig. 1. Arrangement of calendar and section of covers.

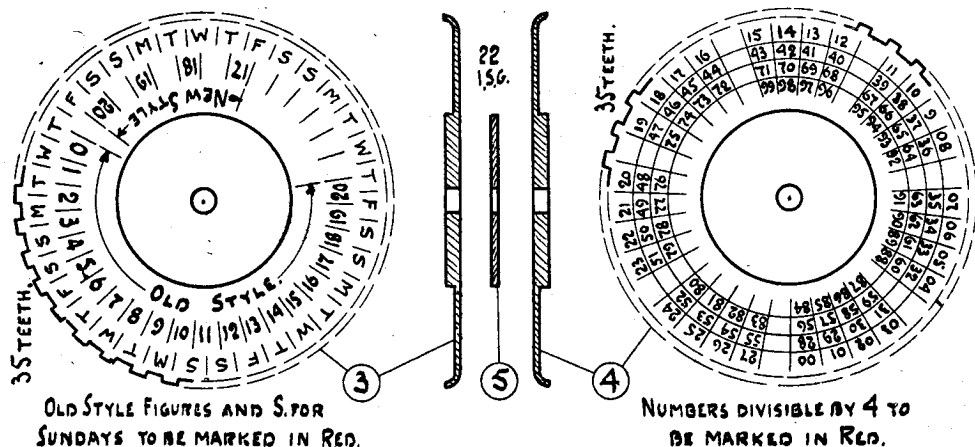


Fig. 2. Details of adjustable discs.

When all is correctly matched and fitted together the two half covers should be spot soldered at, say, eight spots on the circumference; this serves to secure the lot and prevent relative movement of the two covers.

A 35-tooth gear wheel with the bore fitted with a plug having a turned-down spigot, the spigot fitting the centre holes in covers and discs, is of great help in making the divisions.

#### Using the Calendar

- 1st. Set the hundreds on disc 3 to the small slot in cover 1.
- 2nd. Without moving disc 3, set 00 (or zero) on disc 4 over Jan. on cover 2; but when the hundreds are leap years (as all the old style hundreds were) set zero over the Jan. in red.

1st and 2nd are independent movements of discs 3 and 4.

Calendar is now set for the whole of this particular century.

- 3rd. Set the tens and units of the year on disc 4 over the month required on cover 2; in this movement discs 3 and 4 must be moved together.

The days of the week for this particular month may now be read off on cover 1 and disc 3.

The drawing shows the calendar set for the months of Feb., Mar., and Nov., 1942.

When the year is a leap year (as shown by its being marked in red) use the Jan. and Feb. marked in red.

Owing to the change from old style to new style, for the year 1752 up to Sept. 2nd, use the 17 marked in red and from Sept. 14th use the 17 marked in black.

## OLD CHERRY-RED

NOT infrequently, when discussing heat-treatment methods in the workshop, you will hear the remark, "Heat it to a cherry-red, then quench the tool in water, or oil." Unfortunately, this term is sometimes used by steel salesmen and it is not a matter of facts and knowledge, as you may just as well say—"Heat it until it gets pretty red-hot."

The various engineering and metallurgical textbooks and even authorities disagree as to the temperatures corresponding to the various cherry-reds; the following is an average taken from half-a-dozen textbooks and engineering-firm catalogues:—

Blood-red	..	1069° F. (571° C.)
Dark cherry	..	1180° F. (637° C.)
Medium cherry	..	1260° F. (681° C.)

Full cherry	..	1380° F. (748° C.)
Light cherry	..	1500° F. (815° C.)
Bright cherry	..	1560° F. (849° C.)

Therefore, inexperienced hardeners or model engineers will see what they are up against if they try to heat-treat tool or spring steel to cherry-red, because it mainly depends on what kind of cherries they are speaking of, where they are grown and from what part of the tree they are picked.

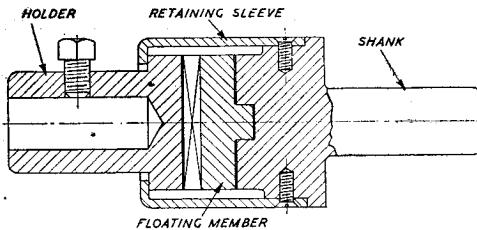
Most tool steels will not harden properly unless they are heated to over 1400° F. (760° C.) and then the temperature range is very limited; therefore, to do the job successfully, discard your cherries and if available use an electric furnace equipped with a pyrometer, and see that it is checked frequently.—A. J. T. E.

# \*Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the small capstan attachment recently described in the "M.E."

By "NED"

IN cases where holes have to be finish-bored to a very precise limit of dimensional and parallel accuracy, there are certain advantages in holding the reamer or sizing cutter in such a way that it is free to find its own alignment with the centre of the hole. This can be done in either of two ways: one, by using a more or less standard form of machine reamer the shank of which is held in a "floating" holder instead of being rigidly fixed in the capstan-head; and the other, by using a holder with its shank mounted in the usual way, but having a "floating" cutter or cutter-head. For obvious reasons, the first is best suited for dealing with small holes, and the second for larger holes.



**Fig. 19. Floating holder for reamers and sizing cutters, to compensate for errors in axial alignment of mandrel and capstan head.**

One form of floating reamer holder is shown in Fig. 19. It embodies a well-known mechanical device known popularly as an "Oldham's coupling," which enables it to accommodate a fairly considerable amount of axial (not angular) misalignment. Note that the more common form of "universal joint," the object of which is to deal with angular misalignment, is not suitable in this instance unless it is used in duplicate.

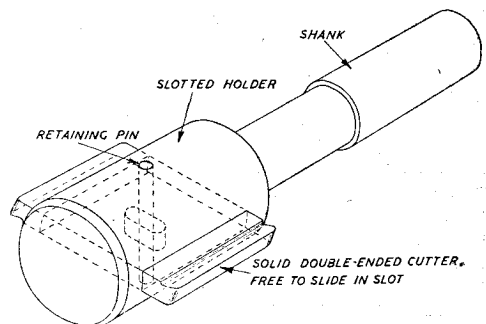
The part of the holder which is attached to, or integral with, the shank, has a key groove cut across its end face, and a similar groove is cut across the flange of the loose holder. Between these two parts is interposed a disc-shaped floating member, having tongues on each of its faces, disposed at right-angles to each other. These engage the grooves of the fixed and loose holders, and the parts are kept in their proper relative positions by means of a retaining sleeve, which prevents end play but allows of a limited amount of eccentric motion.

In a modified form of this type of holder, the retaining sleeve is screwed on to the body, so that it can be drawn up to clamp the loose holder when once the correct location of the latter has been determined. It thus becomes a rigid tool-holder, adjustable to any degree of eccentricity within the limit of motion allowed by the annular clearance in the sleeve.

## Holder for Floating Cutters

A simple type of floating cutter holder for large diameter holes is shown in Fig. 20. This has the holder integral with or rigidly attached to the shank, and provided with a cross slot in which the solid double-ended cutter can slide freely, but with no perceptible play, either endwise or up and down. It is advisable to make the holder as large as possible in diameter, so as to provide the maximum bearing surface for the cutter. A retaining pin through the centre of the holder, and through an elongated hole in the centre of the cutter, is a desirable provision to prevent the cutter becoming inadvertently detached and possibly mislaid.

The cutter should have parallel and carefully ground cutting edges, and its length from edge to edge must correspond exactly with the finished diameter of the hole to be bored. The corners should be eased or rounded off as shown, particularly at the



**Fig. 20. Rigid bar holder for floating flat sizing cutter.**

leading edges. It should not be expected to take out more than a mere scrape—to be more precise, not more than two or three thousandths of an inch on diameter—and the work should run at low speed, whether the material is hard or soft. Regrinding, of course, alters the diameter which the cutter

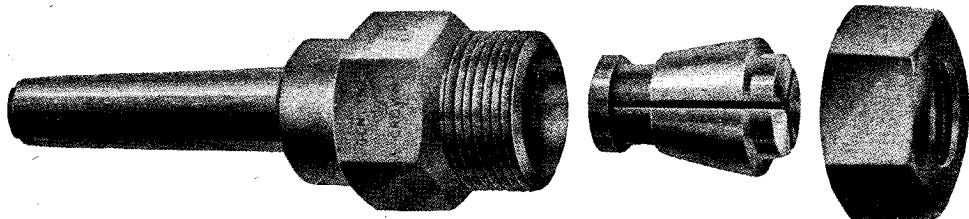
produces, but if used only for fine finishing, it will deal with a considerable number of holes before this becomes necessary. The application of a honing slip to the leading edges from time to time will help to keep it up to working efficiency without affecting accurate sizing.

It should be understood that a cutter mounted in this way is only truly self-aligning in one plane—that of the sliding motion of the cutter. If the holder should be eccentric to the work axis in the vertical plane, that is, at right-angles to the cutter, it will produce a circular error; in order to guard against this, however, it is usually possible to find in what plane the maximum mis-alignment lies, and set the holder accordingly. Most capstan and turret lathes, whether initially inaccurate or having become so through wear, will be found to have the maximum error in a horizontal plane, so that the horizontal position of the cutter will usually be in order.

While the usefulness of floating and self-aligning tool-holders for certain special jobs is beyond question, they are used much

But in modern practice it is almost universal to arrange the system of production so that all work allotted to capstan lathes is capable of being produced with normal tools and methods. Any work which requires specially accurate boring, assuming that it is in other respects suitable for capstan lathe production, is usually dealt with most efficiently by a second operation in a precision boring, internal grinding, or honing machine. It is safe to say that there are many tool setters at the present day who have never seen a floating reamer or boring tool in the course of several years' experience.

Readers of these notes who encounter the need for a more precise finish in bored work than can be obtained with normal fixed-axis tools may find that the simplest solution lies in hand-reaming or internal lapping. A suitable and not excessive allowance should be left in the hole, for the particular operation adopted, and the work accurately re-chucked in any simple lathe or polishing headstock, taking precautions to avoid any possible distortion by the pressure of the chuck jaws.



The components of the "Crown" collet chuck.

less in modern practice than they were some years ago. The main reason for this undoubtedly is the improvement which has taken place in machine tool construction. Much higher standards in the accuracy of alignment of the lathe mandrel and the capstan-head are observed nowadays than they were a few years ago—indeed, they are in many cases rigidly enforced by the modern system of acceptance tests. Despite what is often said about the tender care and attention which was bestowed on the finish and adjustment of lathes in the "good old days," one is inclined to wonder how they would show up according to "Schlesinger limits." On the other hand, however, the skill and care exercised by the modern operator can hardly be said to have undergone a similar improvement, and as floating cutters nearly always call for careful handling in the initial stage of the cut, their use is not always successful in these circumstances. This objection, of course, does not apply to the one-man shop, where planning, toolmaking, setting and operating are all carried out by one pair of hands.

Incidentally, it may be noted that rigidly mounted reamers, flat drills and D-bits have been proved capable of boring holes to within a limit of accuracy of 0.0005 in. on a light model engineers' lathe equipped with a properly made capstan attachment of the type which has been described in these pages. There is, in the circumstances, some justification for the view that special floating tools are hardly necessary in general work; but should further information on their design or construction be considered of general interest, it will be forthcoming.

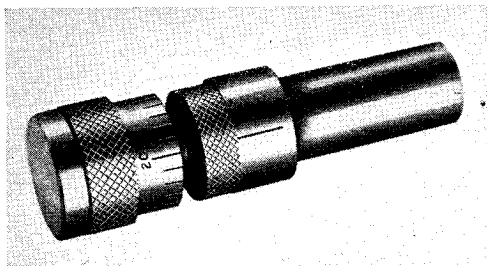
#### Collet Chucks for Drills and Reamers

Since the subject of capstan-head chucks was dealt with, information has been received that sets of high-precision collet chucks are available for this purpose, and Messrs. B. Elliott & Co. Ltd. have furnished particulars of the "Crown" collet chucks, an entirely British product bearing a name with which most readers are familiar in connection with the more "orthodox" self-centring and independent-jaw lathe chucks.

Collet chucks have many practical advan-

tages, as they enable an extremely tight and rigid grip to be obtained without marking or distortion of the bar or tool shank held in them, and maintain their accuracy under the most arduous conditions of service. They also take up less room, both in diameter and length, than most other types of chucks having a similar capacity.

The "Crown" collet chucks are made in sets covering a range of drill sizes from  $5/32$  in. to  $3/8$  in. diameter. Various shank sizes are available, including Morse and Brown and Sharpe tapers, and the ends of



The "Euco" micrometric work stop.

the shanks can be supplied internally tapped for draw bolts. It will be noted that both the bodies and the caps of these chucks are hexagonal, so that they can be operated with ordinary spanners. The loose collets are tempered steel, precision ground, and are split six ways, so that they are sufficiently flexible to accommodate slight variations of diameter.

Besides being readily adaptable for use in a small capstan-head, these chucks are also suitable for use in milling and drilling machines. It would also be possible, by modifying the design of the body, to screw it directly on the mandrel nose of a small lathe, this enabling lengths of small diameter bar to be chucked firmly and accurately.

#### Other Capstan Lathe Specialities

Messrs. Engineering Utilities, Rosedale Works, Rosedale Road, Richmond, Surrey, have furnished particulars of a number of useful tools designed specially for use on small capstan lathes. The first of these is the "Euco" Micrometric Rotating stop, the principal application of which is as a capstan-head work stop to limit the projection of work from the lathe chuck to the correct length required for the finished piece.

The special features of this device are: first, the rotating face, which is mounted on a ball-race so that it rotates with the work as soon as contact is made, thus preventing any scoring of finished surfaces, such as may occur when a fixed stop is used. Should the work not be fed properly up to the stop, or if it is drawn back slightly by

the action of the collet chuck, this is immediately apparent by the fact that the face of the stop ceases to rotate. Secondly, the initial adjustment of the stop is facilitated by the provision of a graduated micrometer screw. The standard shank diameter is  $3/4$  in. dia., and that of the rotating face 1 in. dia.

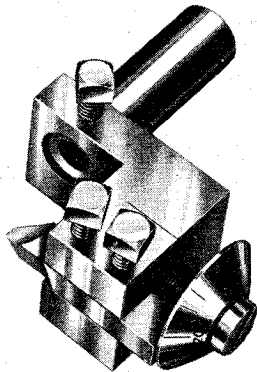
#### The "Euco" Knee Tool

This development of the simple knee tool for running down parallel work (an example of which was fully described in the issue of the "M.E." dated November 6th, 1941) is of interest mainly by reason of the simple but effective means of providing fine adjustment of the cutter. As seen in the illustration, this consists of a micrometer screw with a large diameter graduated head, the flat underside of which bears directly on the end of the cutter itself. The screw has 40 threads per inch, so that one complete turn represents a radial adjustment of 0.025 in., or 0.050 in. on work diameter. It is divided in 25 parts, each of which represents 0.002 in. on work diameter. The cutter is of  $1/2$ -in. by  $1/4$ -in. tool steel, held in an open-fronted slot in the knee bracket by two set-screws, which must, of course, be slackened off to adjust the setting by the micrometer screw.

This tool is made at present in one size only, having a  $3/4$ -in. dia. shank bored with a  $3/8$ -in. hole, to enable the turned-down end of work, up to this diameter, to be accommodated for a much greater length than would otherwise be possible. The maximum diameter which can be turned, in front of the shank, is 1 in.

It is quite obvious that the facility of setting the cutter to fine limits by the micrometer screw is a great advantage over the common method of tapping it through the holder especially when work of the utmost accuracy is required; and it is bound to save considerable time in tool setting.

(To be continued)



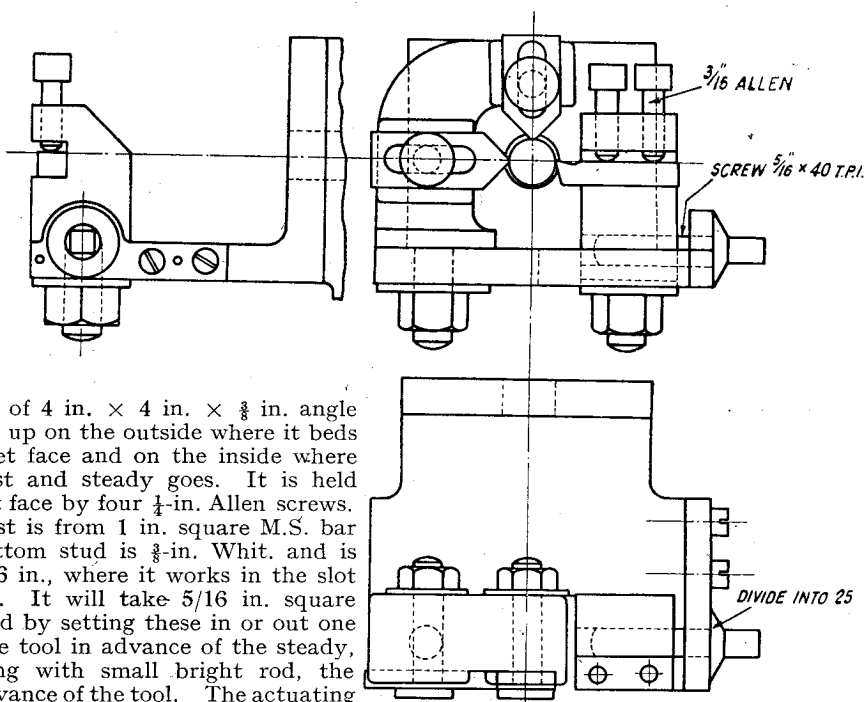
The "Euco" knee tool with micrometer sizing adjustment.

# A Toolholder for the "M.E." Turret Attachment

By E. W. FRASER

THE sketch here reproduced is of a toolholder I have completed for the turret attachment recently described in the "M.E." I would have liked a roller box, but as I wanted to cater for 1/16-in. or 1/8-in. stuff, this idea was shelved. My toolholder was made for a 5-in. pre-war "I.X.L." lathe, but as each box must be made to suit the lathe it is to be used on, dimensions would be useless. I give a few particulars, however, that should enable anyone to construct it. The base is

and the steadies 5/8-in.  $\times$  3/16-in. B.D.M.S. and their bolts are 5/16-in. B.S.F. squared under the head where they fit in the slots in the steadies, the lathe being recessed into the casting a bare 3/16 in. Case-harden the plates deeply and polish and round the points of contact. The tool-post actuating screw can be kept in place by a 1/8-in. grub-screw into a groove in the screw, or as in mine by a tool steel plate having a half-round recess to fit the groove and held in place by



a scrap end of 4 in.  $\times$  4 in.  $\times$  3/8 in. angle just cleaned up on the outside where it beds on the turret face and on the inside where the tool-post and steady goes. It is held to the turret face by four 1/4-in. Allen screws. The tool-post is from 1 in. square M.S. bar and the bottom stud is 3/8-in. Whit. and is squared 7/16 in., where it works in the slot in the base. It will take 5/16 in. square tool-bits, and by setting these in or out one can have the tool in advance of the steady, or in dealing with small bright rod, the steady in advance of the tool. The actuating screw is "M.E." 5/16 in. by 40 t.p.i. and the cone collar is divided into 25, a zero being cut on the top of the retaining plate. This plate is made from 1/4-in. B.D.M.S. bar and the screws holding it are 3/16-in. Whit., and the dowels 1/8-in. SS. Two 3/16-in. Allen screws hold the tool. Case-harden tool-post, screw and plate. The steady is a casting. The director of an engineering firm in the North wrote me via the "M.E." that he had a lathe like mine and would I give particulars. So I made a pattern for the steady for them and they kindly ran me off a couple of castings. So it helped us both. The stud at the bottom is 3/8-in. Whit.

a 3/32-in. countersunk screw. In use, the tool is set approximately and the final adjustment is by screw, but do not forget to slack back the 3/4-in. nut at the bottom. The capacity of mine is 1/2 in. to 1/16 in. and I tested it out on some 4 B.A. special screws in silver-steel and it worked well. Snags? Well, if I made another I would use 1/2-in. angle and let the tool stand another 1 1/2 in. from turret face. Also, I would put a rack and pinion or a screw on the turret attachment. The lever is too jerky and, if you alter the pins to get slower movement, you lose your travel.

# Letters

## Screws

DEAR SIR,—I was very glad to see, in the issue for April 30th, "L.B.S.C.'s" remarks on screw making; this is a matter over which many amateurs are lazy. Considering how simple the job is, it is surprising that they should be, but no doubt the repetition work involved has something to do with this lack of enthusiasm for bolt and screw making.

The fact is, however, as "L.B.S.C." very rightly points out, today if you want screws you must make them, and there is a further point which our friend will, I know, forgive me for making, and that is this: When you have to compete with the idiosyncracies of Inspector Meticulous, in many cases standard screw and bolt heads will be found to be out of scale. In addition, most standard screws and bolts are threaded throughout their length; this materially reduces the strength of the screw.

Both these points may be overcome by making the things for oneself. Like "L.B.S.C.," before the war I was fortunate enough to lay in a supply of suitable material, and being very addicted to the use of B.A. standard screws and bolts, I ordered a good supply of hex. steel in most of the B.A. sizes down to about 10 B.A., with the result that I am in a position to turn out for myself odd combinations such as 5 B.A. bolts, with 6 B.A. size heads, a very useful facility. I can, furthermore, regulate the actual length of the threaded portion.

I notice our friend does not refer to the making of nuts; my own impression is that these are more difficult to get than screws.

A word or two would, I think, be helpful; and as, no doubt, there are others who are, or have been, tackling this problem, can we not get some more information, particularly with a view to speeding up this nut making business, which seems to be the slower of the two jobs?

Yours faithfully,  
"TUBAL CAINE."

## Clubs

### The Society of Model and Experimental Engineers

There will be a Stationary Engine Meeting in The Workshop, 20, Nassau Street, London, W.1, on Monday next, 18th May, 1942, at 7 p.m. The locomotive running stand and the Society's boiler will be available for members who wish to run models under steam. Visitors are cordially invited.

Full particulars of the Society may be obtained on application to the Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

### The Junior Institution of Engineers

Friday, 22nd May, 1942, at The Royal Institution, 21, Albemarle Street, Piccadilly, W.1, at 7.30 p.m. The Ninth Quadrennial Gustave Canet Memorial Lecture, entitled, "Scientific Research and Development in the Empire," by Professor A. V. Hill, F.R.S., M.C., M.P.

### The City of Bradford Model Engineers' Society

Future meetings, etc., of the above Society, are:—

Sunday, May 17th, Channing Hall, at 10.30 a.m., Mr. A. Chubb will give another lecture on "Timekeepers, Ancient and Modern." Mr. Chubb has the ability to put forward his subject in a very interesting manner.

Thursday, June 4th, Channing Hall, at 7.30 p.m., Open Meeting. These meetings are greatly in favour with a large number of our members; there are always some "bits

and pieces" brought along, views, etc., exchanged, and interest is kept at a high level.

Sunday, June 21st, Channing Hall, at 10.30 a.m., a talk will be given by Mr. W. Wood on Press Tools. Mr. Wood is employed on this class of work, so knows his subject very well.

During the months in which double summer time operates, meetings will be held on the first Thursday, and third Sunday of each month, at 7.30 p.m., and 10.30 a.m. respectively.

We extend a warm welcome to members of H.M. Forces stationed in Bradford, and who are interested in model engineering, to attend any of our meetings.

Hon. Sec. and Treasurer, G. BOWER, 33, Moore Avenue, Wibsey, Bradford.

## A Correction

An unfortunate misprint occurred in Messrs. Bassett-Lowke's advertisement in our issue for April 23rd. The "O" gauge G.W.R. Mogul locomotive is not clockwork, but 8-10 volts electric with worm drive.

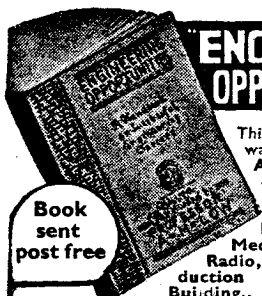
## NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

**Readers desiring to see the Editor personally can only do so by making an appointment in advance.**

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks.

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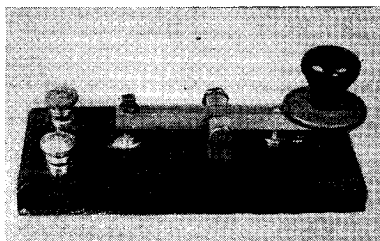
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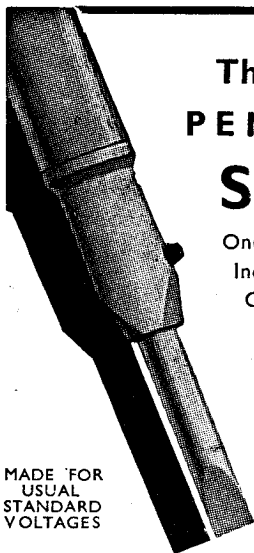
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